Impact of height on spinal anesthesia for elective caesarean section: A retrospective study

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ABSTRACT

Impact of height on spinal anesthesia for elective caesarean section: A retrospective study

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The aim of this study was to compare the level of sensory block in parturients with different body height, after spinal anesthesia with local anesthetic of fixed volume and consistence. This retrospective study was conducted on 107 women, which underwent caesarean section under spinal anesthesia. It was hypothesized that maternal height was not associated with level of sensory block. Parturients were divided into two groups, based on their body height. Group A (n=65) included those with height ≤165 cm and group B (n=42) those with height of ≥166 cm. Subarachnoid space was reached with a 25G needle through the L_3-L_4 spinal space. Then, ropivacaine 20mg and 10mcg fentanyl (in solution of 2.8 ml) was given. The level of spinal anesthesia was assessed and reported 5 minutes after the spinal anesthesia. Hemodynamic parameters were measured every 3 minutes. Titrated doses of ephedrine or phenylephrine were administered as required. Also, Apgar score of the newborn was assessed at 1stand 5th minute. All parturients had adequate spinal block for caesarean section and groups were similar considering the level of spinal anesthesia. Moreover, parturients in the groups had no differences considering systolic and diastolic blood pressure and the use of vasoconstrictor drugs. Finally, Apgar score of the newborns measured at the first and fifth minute after birth was found to be normal and did not differ statistically in both groups. Body height of parturients and level of sensory block after spinal anesthesia with a fixed intrathecal solution for elective caesarean section seems to be two independent variables.

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INTRODUCTION

The practice of spinal anaesthesia for caesarean section is commonplace today in developed countries and numerous local anaesthetic drugs are used as the principal means of producing surgical anaesthetic effect[1]. The greatest challenge of the technique is to control the spread of that local anaesthetic through the cerebrospinal fluid and to provide block that is adequate for caesarean section, without producing unnecessarily extensive spread and so increasing the risk of complications. A fixed dosing regimen is preferred by some anesthetists, others adjust the dose based on patient characteristics.

In spinal anesthesiathere are many factors that affect the intrathecal spread of injected local anaesthetics. However, the influence of most of them is small, unpredictable and beyond the clinician's control. The major factors are the baricity of the solution injected and the subsequent posture of the patient. Manipulation of the factors that affect spread may be used to produce different types of block, as long as the clinician has a clear understanding of what is involved[2].

The characteristics of an ideal spinal anesthetic agent in day care setting would include a rapid onset of a reliable block providing adequate surgical anesthesia of appropriate duration, rapid recovery of sensory and motor block and minimal side-effects[3]. The optimal dose of intrathecal solution would allow dermatome spread but avoid maternal hypotension[2]. In some studies local anesthetic dose has been adjusted with height alone[4] or height and weight[5]. The purpose of our retrospective study was to demonstrate an ideal fixed solution for spinal anesthesia for caesarean section, regardless of the body height of each parturient, which is safe for mother and infant.

Ropivacaine is a long-acting amide local anesthetic agent and a pure S(−) enantiomer of ropivacaine. Ropivacaine, with its efficacy, lower propensity for motor block and reduced potential for CNS toxicity and cardiotoxicity, appears to be an important option for regional anaesthesia[6]. Nowadays, addition of various opioids to local anaesthetics has become a widely used strategy for spinal anesthesia in caesarean section. Fentanyl is a lipophilic opioid and is usually administered at 10 mcg to 25 mcg in combination with local anaesthetics. It has a rapid onset and short duration of action with a reduced need for analgesia after the operation[1].

Hypotension during spinal block, if uncorrected, causes adverse effects on the mother and the neonate. One of the important methods to reduce haemodynamic changes would be to limit wide spread sympathetic block during spinal anesthesia by restricting the spinal segment block desired for a caesarean section. Some studies have identified the patient's height and the sensory block level as risk factors for the

hypotensive episodes in the mother[7], but others have been inconclusive[8]. The aim of this retrospective study was to compare the level of sensory block in parturients with different body height, after spinal anesthesia with local anesthetic of fixed volume and consistence.

MATERIAL AND METHODS

After the approval of the Institutional Ethics Committee and informed consent, one hundred and seven parturients (n=107), ASA I and II, were enrolled in this study. All study patients scheduled or not for caesarean section under spinal anesthesia. The study was conducted in Department of Anaesthesia of General Hospital of Kavala from February 2016 to October 2016. Exclusion study criteria were: preexisting hypertension, preeclampsia, any contraindication to neuraxial anesthesia, multiple pregnancy, placenta previa, active labor, inability to understand the procedure for testing for dermatome height of the neuraxial block, failed spinal anesthesia, allergy to local anesthetics and emergent caesarian section. Most reports demonstrated that the average body height of a normal Greek woman is 166cm[9]. Height cut-off value of 165cm was used to divide the study patients into two groups. Parturients in group A (n=65) with a height ≤165 cm and parturients in group B (n=42) with a height >166 cm.

On arrival in the operating room, intravenous access was obtained with an 18 G or 16 G wide bore catheter. All patients were preloaded with a balanced crystalloid solution (10ml/kg) over 10 min before inducing spinal anesthesia. Our routine perioperative monitoring included continuous SpO_2, electrocardiograph and noninvasive blood pressure monitoring. Subarachnoid block was administered with the patient in the sitting position. Using all aseptic precautions a 25 G pencil point spinal needle at the L3–4 vertebral inter space using median approach. After aspirating cerebrospinal fluid, all patients received with slow speed 20 mg ropivacaine and 10mcg fentanyl. Intrathecal solution was placed in a 5 ml syringe and the final volume was 2.8 ml. Patients were immediately turned supine and a wedge was placed under the right flank to achieve a 15° left lateral tilt. Supplemental oxygen at 3 L/min was given to all patients via face mask.

The primary outcome measurement was level of sensory block. Bilateral sensory block height, in the midclavicular line, was determined 5 minutes after subarachnoid injection, using both cold sensation modalities in response to ethyl chloride. We transformed the level of the neurotomes in matching numbers, so levels above T3 corresponds to the number 1, the T3 in the number 2, the T4 in the number 3, the T5 in the number 4 and all the neurotomes below the T5 in 5. For the main core of the statistical analysis, it was our goal to prove that the different body height of the parturients and the level of sensory block are in our own case and in any

case using the solution we study, two completely independent factors.

Secondary outcome measurements include: systolic and diastolic blood pressure, vasoconstrictors drugs administration and Apgar score at 1st and 5th minute. Blood pressureswere recorded every 3 minutes after spinal anesthesia for the first 21minutes (T0, T3, T6, T9, T12, T15, T18, T21).Vasopressors are routinely used to counteract hypotension after neuraxial anesthesia in obstetrics. Bolus ephedrine (dose of 5 mg) or phenylephrine (dose of 50mcg) was administered if needed to maintain blood pressure. Due to the absence of definitive evidence showing absolute clinical benefit of one over the other vasoconstrictors, our choice of phenylephrine or ephedrinewas guided by anesthesiologist preference.

The Apgar score of the newborn was recorded in the first minute and again five minutes after birth. In the Apgar score, five parameters are estimated: Heart rate, breathing, muscle tone, reflex response to the stimuli and color of the skin. Each parameter is scored on a scale from 0 to 2 and these numbers are added together. The highest rating is 10 and score of 8 to 10 means that the child is in excellent condition[10].

All quantitative variables are reported as mean and standard deviation, and qualitative variables are listed as number (percentage). Age was compared between the two groups by Student's t-test (2-tailed). Weight, BMI and sensory block were compared using the Mann-Whitney test. ASA physical status, use of vasoconstrictor drugs and Apgar score data were compared by Pearson Chi-square test. Linear mixed model was used to evaluate the difference of systolic and diastolic blood pressure at different time points between the groups throughout the study. In all these evaluations, multiple comparisons were corrected by Bonferroni method. Statistical Package for Social Sciences (SPSS, version 23; SPSS Inc., Chicago, IL, USA) was used for all calculations. Results are expressed as an adjusted rate with 95% confidence intervals (CIs).p values less than .05 were considered significant.

RESULTS

The number of parturients, as separated after screening in the two groups, were 65 for group A (body height ≤165 cm) and 42 for group B (body height ≥166 cm). There were no significant differences between the two groups in demographic data and clinical characteristics (Table 1).

Based on the transformation of the level into numbers, in group A, the mean value of the data was 2.6923±0.983 while in group B 3.0476±0.7309 (Table 2). From Mann-Whitney Test, we get that body height and level of the sensory block are independent and the difference between the two groups is not statistically significant (U = 1094.00, 95% CI [-0.999, 0.001], p = 0.067 > 0.05)

Table 1. Demographic and clinical characteristics of study patients

		Group A	Group B	p
Age (Yrs)*		28.3 (9.22)	28.8 (7.07)	0.59[a]
Weight (Kg)*		82.3 (3.07)	79.67 (2.3)	0.37[b]
BMI (kg/m_2)*		29.57 (8.74)	27.27 (7.56)	0.28[b]
ASA N, (%)	**1**	35, (53.8 %)	22, (52.4%)	0.19[c]
	2	30, (46.2%)	20, (47.6%)	

Values are mean (standard deviation) or number (proportion, %), BMI: body mass index, ASA: American Society of Anesthesiologists. [a]Based on t-test, [b] based on M-W test,[c] based on Chi-Square test.*

Table 2. Level of sensory block in study groups

Level of sensory block	Group A	Group B	p*
1 (<T3)	9	0	0.067 (CI – 0.999, 0.001)
2 (T3)	16	10	
3 (T4)	27	20	
4 (T5)	12	12	
5 (>T5)	1	0	
Mean value	2.6923 (0.98)	3.0476 (0.73)	

*Values are mean (standard deviation) ,CI: Confidence interval 95%,*based on Mann-Whitney test.*

No statistically significant differences were observed in systolic pressure (p=0.623) and diastolic pressure (p=0.526) during the first 21 minutes and at each time point (every 3 minutes) (Table 3). Moreover, there were no significant differences in vasoconstrictor drugs administration (95% CI [0.308, 0.075], p=0.248), Apgar score 1st minute (955 CI [0.208, 0.170], p=0.844) and Apgar score 5th minute (95% CI [0.272, 0.129], p=0.482) when comparing the group A and group B (Table 4).

Table 3. Hemodynamic variables.

SAP									
Groups	**T0**	**T3**	**T6**	**T9**	**T12**	**T15**	**T18**	**T21**	**p_1***
A	118.4 (12.2)	101.8 (12.4)	101.3 (12.3)	104.8 (9.2)	108.4 (9.96)	111.1 (8.94)	111 (6.51)	113.1 (6.15)	0.623
B	117.2 (10.9)	100.8 (9.93)	100.3 (10.3)	105.6 (8.79)	109.2 (9.11)	112.7 (8.47)	108.8 (17.6)	113.9 (5.93)	
p_2*	p=0.606	p=0.65	p=0.65	p=0.63	p=0.69	p=0.37	p=0.34	p=0.48	
CI	[-3.415, 5.829]	[-3.495, 5.551]	[-3.525, 5.566]	[-4.394, 2.706]	[-4.544, 3.021]	[-4.99, 1.877]	[-2.49, 7.015]	[-3.22, 1.537]	

DAP									
Groups	**T0**	**T3**	**T6**	**T9**	**T12**	**T15**	**T18**	**T21**	**p_1***
A	69.95 (1.84)	66.77 (5.2)	66.72 (3.81)	68 (3.76)	69.57 (2.36)	70.03 (1.73)	68.86 (3.53)	69.12 (3.91)	0.623
B	69.67 (2.03)	66.1 (0.42)	65.6 (2.91)	68 (3.84)	69.07 (2.48)	69.52 (2.12)	67.43 (3.62)	67.88 (3.93)	
p_2*	p=0.451	p=0.49	p=0.10	p=0.99	p=0.29	p=0.17	p=0.05	p=0.11	
CI	[-0.466, 1.040]	[-1.25, 2.601]	[-0.24, 2.497]	[-1.48, 1.489]	[-0.44, 1.443]	[-0.23, 1.250]	[-0.35, 2.831]	[-0.29, 2.780]	

Values are mean (standard deviation). SAP: systolic blood pressure (mmHg), DAP: diastolic blood pressure (mmHg), p_1= during the first 21 minutes after intrathecal administration, p_2 = at each time point, CI: Confidence interval 95%

Table 4: Vasoconstrictor drugs and Apgar score

Parameter			**Group A (%)**	**Group B (%)**	**p***
Vasoconstrictors use			24 (36.92%)	11(26.19%)	0.248, CI [0.308, 0.075]
Apgar score	**1st min**	9/10	39 (60%)	26 (61.90%)	0.844, CI [0.208, 0.170]
		10/10	26 (40%)	16 (38.10%)	
	5th min	9/10	19 (29.23%)	15 (35.71%)	0.482, CI [0.272, 0.129]
		10/10	46 (70.77%)	27 (64.29%)	

**based on Chi-Square test. Data are presented as number (proportion, %), CI: Confidence interval 95%.*

DISCUSSION

Our study indicated that body height of parturients and level of sensory block after spinal anesthesia with a fixed intrathecal solution of 20 mg of ropivacaine 0.75% and 10mcg of fenta-

nyl for caesarean section are two completely independent variables. The groups were statistically comparable and there was not statistical difference considering the level of spinal anesthesia. All parturients in our study had adequate spinal block for caesarean section (above T5 level).Moreover, parturients in the groups had no differences considering systolic and diastolic blood pressure and the use of vasoconstrictor drugs. Finally, the Apgar score of the newborns measured at the first and fifth minute after birth was found to be normal and did not differ statistically in the groups.

To achieve a sensory block of T_4, a dose of ropivacaine of 18-20 mg is required[11].In other bibliographic references, a recommended dose of up to 25 mg is reported[12,13]. Our clinical experience involving approximately 350-400 spinal anesthetics for caesarean section per annum is that 20 mg is an effective dose. Addition of various opioids to local anaesthetics has become a widely used strategy for spinal anesthesia in caesarean section, which may improve intra- and post-operative analgesic effects and reduce side effects[14]. In our study, 10mcg fentanyl was added in the final dose of local anesthetic.

Low-dose spinal anaesthesia has been advocated in the interests of improving cardiovascular stability.However, current knowledge concerning spinal anaesthetictechnique makes cardiovascular instability easy to prevent. Therefore, adequate surgical anaesthesia is more important during caesarian section than cardiovascular instability[15]. In 2011, a meta-analysis demonstrates that low-dose bupivacaine in spinal anaesthesia compromises anaesthetic efficacy, despite the benefit of lower maternal side-effects such as hypotension and nausea/vomiting[16].

No conclusive evidence exists on the effect of patient height on the spread of spinal anaesthesia[16].Studies investigating the relationship between patient body height and block height in obstetrics are limited and show conflicting results.Logic might suggest that taller patients would display less cephalad spread for a given amount of local anaesthetic. Indeed, minimum effective doses have been calculated for caesarean section (0.06 mg cm−1 height) and the use of a dose of hyperbaric bupivacaine adjusted to patient's weight and height has shown to limit the spinal segment block spread[4].

In a recent prospective controlled trial, She et al[17]concluded that the response to modest intrathecal doses of ropivacaine did not differ between taller or shorter patients. However, a larger dose of ropivacaine was associated with an increased incidence of hypotension in shorter patients compared to that in taller patients.In another randomized double-blind clinical trial, Siddiqui et al[5]compared two groups, where in first group the local anesthetic dose was adjusted according to height and weight, and in the

second, according to height only. They demonstrated that adjusting the dose of isobaric bupivacaine to a patient's height and weight provides adequate anesthesia for elective caesarean section and is associated with a decreased incidence and severity of maternal hypotension and less use of ephedrine.

In 2011, Subediet al[18] compared spinal anesthesia using intrathecal hyperbaric bupivacaine between height and weight adjusted dose and fixed dose during caesarean section. They concluded that bupivacaine dose was significantly reduced on its dose adjustment for the body weight and height of patients. This adjusted-dose use suitably restricted spinal block level for cesarean section with a distinct advantage of less hypotension and with a similar neonatal outcome as fixed compared with the dose use.On the other hand, Harten et al[19]after a prospective, randomised, double-blind study concluded that adjusting the spinal anesthesia dose regimen for caesarean section according to the patient weight and height results in less hypotension and fewer blocks above the T1 dermatome level, when compared to a fixed dose.

In earlier studies, Norriset al[20] showed no correlation between the body height and the height of sensory block after a fixed dose of 15mg hyperbaric bupivacaine administration and demonstrated that it is not necessary to vary the dose of injected local anesthetic. Another study that have looked at the effect of height has shown more extensive spread in shorter patients[21]. The main reason for this is that most of the difference in height between adults is due to the length of the lower limb long bones, not the spine. When spinal length (i.e. distance from C7 to the sacral hiatus) was related to block height, a much better correlation was obtained[22].

An extensive sensory block level readily contributes to the high incidence of hypotension after spinal anesthesia in parturients, increasing the risk of maternal discomfort and fetal anoxia. Various studies have revealed that spinal anesthesia-induced hypotension occurs at a high incidence after sensory block at the level of >T4 in parturients. These findings are supported by the fact that nerve fibers affecting the vasomotor tone of the arterial and venous vessels arise from T5–L1 and that cardio accelerator fibers arise from T1–T4[23]. Considering secondary outcomes in the present study, no between-group differences have been shown in systolic and diastolic pressure and Apgar score in 1st and 5th minute. Vasoconstrictors requirements during the first 21 minutes of SA were equivalent between the two groups. Possible reason for our results of hemodynamic variables and newborn scores was that there was no difference of spinal height between the groups.

Limitations of this study include the fact that it was a retrospective study. The majority of studies carried out in pregnant women and parturients are retrospective, since it is a difficult and

perhaps a morally questionable topic, whether we can perform a prospective study in such population[24]. Moreover, our results do not apply to patients in whom emergent or prolonged surgery is envisaged. In these cases, combined spinal epidural anesthesia, continuous spinal anesthesia, or general anesthesia might be required. Finally, we did not record how many times vasoconstriction agents were administered.

CONCLUSION

Body height of parturients and level of sensory block after spinal anesthesia with a fixed intrathecal solution for elective caesarean section seems to be two independent variables. Hence, further research is required to reach a clear conclusion.

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Author Disclosures:

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